



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

SCIENCE

FRIDAY, FEBRUARY 9, 1912

CONTENTS

<i>The Measure of a Singer:</i> PROFESSOR CARL E. SEASHORE	201
<i>The American School Hygiene Association</i> ..	212
<i>The Rockefeller Foundation</i>	213
<i>Scientific Notes and News</i>	213
<i>University and Educational News</i>	215
<i>Discussion and Correspondence:—</i>	
<i>The Formation of Clouds over Fires:</i> WALTER N. LACY. <i>Endocrypta huntsmani:</i> C. MCLEAN FRASER	215
<i>Scientific Books:—</i>	
<i>Howard on the House Fly:</i> PROFESSOR JOHN B. SMITH. <i>Jongmans's Die Paleobotanische Literatur:</i> DR. EDWARD W. BERRY	216
<i>Scientific Journals and Articles</i>	217
<i>Notes on Entomology:</i> DR. NATHAN BANKS .	217
<i>Special Articles:—</i>	
<i>A New Genus of Rhinoceros from the Lower Miocene:</i> HAROLD JAMES COOK	219
<i>The American Association for the Advancement of Science:—</i>	
<i>Section A—Mathematics and Astronomy:</i> PROFESSOR G. A. MILLER	220
<i>The Association of American Geographers:</i> PROFESSOR ALBERT PERRY BRIGHAM	222
<i>The Society of American Bacteriologists:</i> DR. CHARLES E. MARSHALL	222

THE MEASURE OF A SINGER¹

THE historian of the future will probably characterize the period upon which we are now entering in psychology as the period of the rise of the applied psychological sciences. It may, therefore, be meet and proper to take some fundamental concept of applied psychology as topic for this annual address. I select for this purpose the rôle of mental measurement—the possibility, the scope and the meaning of mental measurements as the foundation of applied mental sciences.

In order to illustrate the scope and significance of mental measurement in a concrete and specific instance, I shall make bold to present a psychological outline of the measurement of an individual as a singer. Let us make the assumption that this individual is a girl, fifteen years of age, who has had musical training and now desires the best obtainable advice from a consulting psychologist in music in regard to her future prospects as a singer.

Musical power is generally admitted to embrace certain well-recognized and fairly concrete capacities. In our commonplace judgment about ourselves and others we say: "I have no ear for music." "I can not tell a chord from a discord." "I can not keep time." "I have no sense of rhythm." "I can not tell a two-step from a waltz." "I can not remember music." "I can not image sounds." "I am not moved by music." "I do not enjoy music." Or, if speaking of some one who has musical ability, we say: "He has a

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

¹ The annual address before the American Psychological Association, Washington, D. C., December, 1911.

deep rich voice." "He never forgets an air." "He lives in song." Such judgments have reference to generally admitted specific factors involved in musical capacity by virtue of a musical organization. Corresponding to these judgments of native capacity we have judgments about musical education, about musical environment, about special influences and stimuli for the development of musical talent, and about technique and success in the rendition of music. When judgments of this kind are based upon measurements, classified, and adequately interpreted, they may constitute a measure of the individual as a singer.

Unfortunately, we have not the command of an expert in the psychology of music, and the field before us is practically unworked. The illustration will, therefore, be merely a tentative suggestion to blaze the trail a little way.

The measure of a singer should consist of a relatively small number of representative measurements upon specific capacities and achievements. These measurements must be set in a full survey by systematic observation and other verified information bearing upon the valuation of the individual as a singer.

The classification of the measurements must be based upon (1) the attributes of sound which constitute the objective aspect of music, and (2) upon fundamental and essential processes in the singer's appreciation and expression of music.

From the point of view of the objective sound, we must take into account pitch (with its complexes of timbre and harmony), intensity and duration.² From the point of view of mental processes, we may group the tests under the heads, sensory,

²Localization of the tone is irrelevant and the spatial attribute of volume may for the present purpose be considered with intensity.

motor, associational, and affective, each of these furnishing natural subdivisions. The measurements may thus be arranged in the following program, which should also be the outline for a systematic description.

LIST OF MEASUREMENTS ON A SINGER

I. Sensory.

A. Pitch.

1. Discrimination at α' , 435 vd.
2. Survey of register of discrimination.
3. Tonal range, (*a*) upper, (*b*) lower.
4. Timbre—discrimination.
5. Consonance and dissonance.

B. Intensity.

1. Sensibility.
2. Discrimination.

C. Time discrimination for short intervals.

II. Motor.

A. Pitch.

1. Striking a tone.
2. Varying a tone.
3. Singing intervals.
4. Sustaining a tone.
5. Registers.
6. Timbre: (*a*) purity; (*b*) richness; (*c*) mellowness; (*d*) clearness; (*e*) flexibility.
7. Plasticity: curves of learning.

B. Intensity.

1. Natural strength and volume of voice.
2. Voluntary control.

C. Time.

1. Motor ability.
2. Transition and attack.
3. Singing in time.
4. Singing in rhythm.

III. Associational.

A. Imagery.

1. Type.
2. Rôle of auditory and motor image.

B. Memory.

1. Memory span.
2. Retention.
3. Redintegration.

C. Ideation.

1. Association type and musical content.
2. Musical grasp.
3. Creative imagination.
4. Plasticity: curves of learning.

IV. Affective.

- A. Likes and dislikes: character of musical appeal.

1. Pitch, timbre and harmony.
2. Intensity and volume.
3. Time and rhythm.
- B. Reaction to musical effect.
- C. Power of interpretation in singing.

The object of the sensory measurements is to determine to what extent the individual is psycho-physically capable of hearing music. For pitch appreciation, we may measure the discrimination, making sure that we reach the physiological as opposed to the cognitive limit of the perception of difference.³ A rapid survey at about twelve selected points within the range of pitch from 25 vd. to 2,500 vd. will suffice to ascertain if there are any gaps or any other peculiarities in the auditory sensibility to pitch within the range of tones which may be heard as musical. If any peculiarity is found, it may be surveyed in detail. To measure the tonal range of the ear, we determine the upper and the lower limit of sensibility to tone. The upper limit is, however, by far the most variable and important as a factor in musical hearing. The two ears may differ materially in range.

The perception of timbre may be measured by the ability to distinguish a pure tone from a series of artificially built-up clangs.⁴ The ability to analyze clangs

³ The cognitive limit is the limit set by lack of knowledge or training; the physiological is the limit beyond which one can not improve.

⁴ We suffer great confusion at the present time in regard to the use of the term, "quality" of tones. Psychologically, pitch is the quality of the tone, but in physics, oratory, music, and untechnical language, "quality" is used in the sense of timbre, tone-color, or character of the clang. Psychologically, the word, "timbre," alone should be used in this sense. It is timbre which distinguishes the tones of different instruments, the tenor from the bass when singing the same note, or the vowels of our speech. In each of these cases there is only a difference in the number of overtones and their relative dominance, for the tone is ordinarily a clang built up by the combination of a number of

varies with training, and should only be used as a measure of acquired efficiency or skill, although the capacity for such skill is determined mainly by the natural sensory capacity for perception of difference in timbre.

While the perception of consonance and dissonance depends largely upon training, there are fixed limitations in the natural sensory capacity which limit the possibility for appreciating the agreeableness or disagreeableness of combinations of tones. This ability may be measured by determining the ability of the singer in arranging a series of pairs of tones in the order of their consonance.

For the attribute of intensity, we should have at least two sensory measures: (1) the threshold of sensibility to tones in each ear; and (2) the discrimination for variations in the strength of a familiar, relatively pure, musical tone. These measures will show the natural capacity of the individual for the hearing of faint tones, the hearing of intensity accent, and the hearing of shadings in the strength and volume of tones in musical expression. The perception of volume is so intimately dependent upon the perception of strength of tone, that a separate measure is not needed.

While the perception of time is largely associational, we depend ultimately upon the sensory capacity for the perception of short durations and rhythmic effects. Rhythm may be expressed through both time and intensity. For a single measure of the perception of rhythm as a time element, we may eliminate intensity and measure the least perceptible deviation in the duration of the recurrent sound, uniform in all respects except duration. This, taken

partials or overtones, each having a pitch of its own. Timbre may therefore be regarded as a pitch complex.

together with the measure of intensity-discrimination, should correlate well with the measure of the perception of intensity in rhythm-accent.

In the survey of the motor capacity of the singer, we naturally follow the same divisions, according to the attributes of tones, as in the sensory; namely, pitch, intensity and duration of tones. There are four fundamental phases of simple pitch singing which should be examined separately: (1) simple ability to reproduce the pitch of a tone heard one second before the singing; (2) the ability to make faint shadings (sharp and flat) in pitch, (3) the ability to sing intervals, and (4) the ability to sustain a tone, both with reference to periodic and progressive changes in pitch. The record of the ability to sound the pitch of the tone should be taken at c' , 256 vd., and at points near the upper and the lower limits of the musical register of the voice. The voluntary control of the pitch of the voice, measured in terms of the minimal producible, sharp or flat, should all be recorded at the same three points in the register. The measure of ability in singing intervals should be taken (*a*) for two or three relatively pure intervals near the middle of the register of the voice, (*b*) for the singing of the natural scale, and (*c*) for the singing of the chromatic scale. The ability in the sustaining of the pitch of a tone for ten seconds may also be measured at the three representative levels of the register and should be so recorded as to show both progressive and periodic changes. Progressive changes are tendencies to gradually sharp or flat: periodic changes may be either regular or irregular oscillations in pitch, or a general lack of control.

The register of the voice should be stated in terms of the characteristic changes in timbre which take place near the upper

and the lower limits. Thus we may determine the range for agreeable musical tones, for tones easily sung, for chest tones and for true pitch singing. This series of records should be supplemented by a systematic description of the progressive change in the character of the tone from one end of the register to the other.

Under the head of timbre of the voice, the psychological-esthetic effect we seek to establish is the degree of beauty of the objective tone. We therefore eliminate subjective and circumstantial conditions and accessory features of the singing which may modify the agreeableness and disagreeableness of the given tone and consider only beauty as it is objective in the physical tone. This may be measured with considerable precision in terms of the form of the sound wave. From a single, well-chosen, graphic record of the voice, we may work out the following factors: (*a*) purity, the degree of approach to the smooth sine curve in the form of the wave; (*b*) richness, the number of overtones present; (*c*) mellowness, the character of the distribution of the overtones; (*d*) clearness, the uniformity in the form of a series of waves; (*e*) flexibility, the character of the progressive transition from one wave form to another. These purely objective measures of the beauty of the tone must be supplemented by systematic observations on the agreeableness of the timbre of the voice by experts judging separately each of the specific qualitative aspects of the voice as naturally used in singing. Objective record must also be made on the mode of tone production, especially characteristics of the resonance.

The plasticity of the individual in a given capacity is measured by the rate and character of the learning processes in that capacity. We now know enough about the characteristics of learning curves to be able

to determine in a relatively small number of trials the character of the prospect that an individual may have for acquiring skill in any given activity. The plasticity may be measured in this way for any of the motor processes of musical training. If but a single measure of plasticity is to be made, this may well be on the training in accuracy of transition from one note to another, involving the elements of release and attack.

As regards intensity of tone production, we are interested in the natural strength and volume of the tone and in the voluntary control of these factors. The strength of tone is expressed in terms of amplitude of vibration and should be measured in representative parts of the register. In so far as they differ from strength, carrying power and volume may be judged essentially in terms of the mode of tone production. Voluntary control of the strength of tone may also be measured in terms of the amplitude of the vibration. The measurement of voluntary control in the making of fine differences in volume, or in the change of volume as distinct from intensity of tone, is too complicated for our present purpose, but systematic observation of this in ordinary singing is essential.

Motor ability may be measured in terms of the degree of accuracy in the rapid enunciation of a selected list of syllables. The form of the attack is also an excellent measure of time-efficiency in musical action. But the most important of all time measurements is of course the ability to sing in accurate time and rhythm. For time alone, we test the singing of equal durations without accent. For rhythm, in the true sense, the singing must be with time and intensity variables together as in ordinary singing. The measure should be made for both simple and complex rhythm.⁵

⁵ In measurements of motor ability, and rhythm in actual singing, the dictograph or some similar

A number of tests may be grouped under the general head of association, and these may be subdivided somewhat arbitrarily as in the outlined list. We should first secure a quantitative picture of the relative vividness of images from the different senses. Then the auditory image should be tested for fidelity, stability and relevance, in such a way as to reflect the rôle and power of auditory imagery in singing. The same may also be done for motor imagery.

The most fundamental fact about memory is the memory span for musical tones. This may be measured in terms of the number of tones (taken from a single octave, but not forming a known melody) the individual can remember for immediate reproduction or recognition. The power of retention may be measured by determining roughly the extent to which the singer can recall music heard a day or a week before. The power of musical redintegration may be tested by observing to what extent the individual can recall, in their true setting, the fine details of a complex musical production. Here the phonograph can be used to good advantage.

Association type may be given as the name for the sampling of the mental content and the prevailing mode of reaction as determined by free association experiments in what is now called psychoanalysis. This will show, for example, whether the individual lives in music objectively or if the music is to him merely a series of affective stimuli which arouse a feeling of idealized beauty. Most of the relevant facts which may be determined objectively by such diagnostic association tests may, however, be obtained by the expert through direct and unaided observation.

To the musical mind the sounds group themselves in large units, such as themes, movements, phrases, etc. The power of instrument may be used to excellent advantage.

grasp for musical complexes may be measured in terms of a graded series of complexes of musical units, taking in turn the various factors of pitch (including timbre and harmony), intensity and time.

A record of creative imagination may be obtained under experimental conditions by allowing the singer to improvise a tune for a selected stanza. The words of a series of stanzas should convey different types of emotional value. The ability may then be measured in terms of the merit of such a composition as preserved in the dictograph. Here the greatest freedom should be allowed the singer for spontaneous expression.

As knowledge of ability in learning music is essential, the mode of forming, and the natural ability for acquiring, new musical associations should be measured for one or more phases of vocal training, such as the placing of the voice, singing the chromatic intervals, or the analysis of clangs. If a single representative measure were to be made, this might profitably be the establishment of the learning curve for the singing of the untempered chromatic scale.

The affective phase of music is never isolated from the cognitive and motor elements, for both of these always involve some feeling. In such measurements as those of consonance, association type and creative imagination, we deal with facts which are quite as relevant to the affective as to the cognitive side of consciousness. The same principle applies also to some of the motor examples. The musical emotions are conditioned upon the various powers of appreciation and expression which we have just reviewed. Unless our singer has capacity for hearing or expressing a given musical effect, she can not experience emotional pleasure over it. The sensory, motor and associational measure-

ments have therefore determined the presence or absence of capacity for affective or emotional appreciation and expression. There are, however, three general surveys which are of a positive and fundamental nature; namely, musical preferences, reaction to musical effects and power of interpretation in singing.

One affective aspect of the character of the musical appreciation may be determined by working out the curve of likes and dislikes for representative series of musical selections. These should be so arranged as to represent the main types of musical appeal through each of the attributes of sound. Here the measurement may be standardized by having the graded selections furnished in a series of the best quality of phonograph discs. Three series might be used: (1) Pitch, timbre and harmony series; (2) the intensity and volume series; and (3) the time or rhythm series.

The amount and character of reaction to different musical effects may be observed under experimental conditions when the observer is not aware that this is being done; thus, a systematic record of such observations may be made under the guise of repeating the preceding measurement (IV., A, 1) in which the observer works by the method of impression just outlined. The curve for different kinds of mental and physical reactions observed may be made to parallel and supplement the curves for agreeableness and disagreeableness.

There are two aspects to the power of interpretation of music in singing; namely, the appreciation and the expression. Since expression involves appreciation, measurement on appreciation may be omitted. The power of expression may be measured by methods now in vogue for the measuring of merit. Musical experts may be obtained to make comparisons of one

specific element after another in singing under experimental conditions.

As a supplement to these measurements, there must be other measurements, statistical data, biographical information, and free observations regarding musical training, traits of temperament and attitude, spontaneous tendencies in the pursuit of music, general education and non-musical accomplishments, social circumstances and physique.

With this tentative plan of procedure before us as a concrete thing to consider, let us ask and answer the following three questions: How do these measurements acquire unity in meaning? Do they constitute an adequate measure of the singer? Of what practical significance can they be?

With reference to the first of these questions, it can readily be seen that a group of measurements like this is merely a group of samples of measurement. Their unity in meaning depends upon the degree to which they are adequately representative, and are interpreted in true perspective. They are meaningful only when compared with previously established norms, which show the mode and extent of distribution for a sufficiently large number of cases, and are interpreted in the light of the meaning ascribed to each level in the distribution. Take, for illustration, discriminative action in voluntary control of the pitch of the voice in singing. Reference to our norms shows, for example, that a record of .9 vd. means that this ability is within 3 per cent. of the best record for individuals under similar conditions, and that those who have such control are thoroughly qualified to render a high class of music in this respect; while a record of 9 vd. falls within 8 per cent. of the poorest ability measured, and is characteristic of an individual who can not sing; whereas 3 vd. represents the average ability of an untrained individual.

These norms must be worked out with much labor and skill in the interest of an avowedly applied psychology, and must be considered as problems in themselves before any measurements can be of service. During the last year or two a group of research men in the Iowa laboratory have been engaged in working out eight such norms in the psychology of music. After extensive preliminary development of methods and measuring instruments, they have aimed to secure records on two hundred individuals, constituting a homogeneous group for each norm. These norms are: pitch discrimination, vividness of tone imagery, span of tone memory, consonance and dissonance, rhythmic action, intensity discrimination, voluntary control of the pitch of the voice, and the singing of intervals. This is no simple undertaking, and so far the work can only be said to be preliminary. It requires the development of technique for each case, and the measurement must be taken for as many conditions as it is desired to vary under control.

This technique can not be mechanized so that every music teacher can handle it. Even after means and methods have been invented and standardized and norms have been established, it requires an expert, trained in the technique and skilled in the art. This is a field for the consulting psychologist in music, a person who devotes himself to this kind of work professionally. He must not only be able to determine the relative rank of a record by reference to the normal chart, but he must also be able to interpret the meaning of this rank in the light of the construction which has been placed upon the norm. He must be not only a technician, but an artist with appreciation for music, full of ingenuity, sympathetic and incisive in his interpretation. Like the so-called mind reader, he must have at his command a

large repertory of procedures, and be skilled in gathering information from all sorts of expected and unexpected sources during the experimental control. In this art he progressively simplifies procedure, divests himself of mechanical contrivances wherever possible, and takes the singer under more and more natural conditions.

The expert in mental measurement always remembers that the human individual is a psycho-physical organism. He must have records for the physical as well as the mental, and especially for their relationships; and he must interpret each fact, physical or mental, as a feature of an organism, bearing in mind that there is organization in the mental, just as truly as in the physical. With a clear grasp, on the one hand, of the fundamental attributes of objective music, and, on the other hand, of the fundamental capacities of the human organism for appreciating and rendering music, he must select that group of measurements which will answer his purpose: it may be a problem of learning; it may be an attempt to trace the nature of a discovered fault; it may be the proving-up of progress made under a given mode of training. Our present schedule of measurements is merely a sort of relief map for first orientation. The unity of the whole, or of any section, of such measurements lies in the effectiveness with which they serve one purpose.

In this work, systematic observation and description is supplemented by the concrete objective measurements. One of the main purposes of measurement is to secure experimental control of conditions in which systematic observation of factors under control may be recorded, though not a part of the numerical record.

Instead of neglecting what can be known by "common sense," as is often charged, the expert starts with this at its best, grad-

ually culls and sifts his facts in systematic observation, and finally clinches a few of the representative features in objective measurements. The charge that the so-called "practical man" knows more through direct impression, or common sense, than the expert can discover scientifically is a flagrant expression of ignorance. The effect of the scientific point of view is not to belittle the magnitude of music or man. But, as the astronomer sees more in the starry heavens than does the average man on a moonlight stroll, so the expert beholds in music and in the human individual vastly more than the so-called "ordinary man," in this case the mere musician, observes; for his vision is closer, more detailed, more keenly discriminating, recordable, repeatable and more penetrating.

In the Gibson girl we see a most realistic representation of form, face, hand, heart and mind. No stroke by itself has any meaning; no feature is really drawn; no mental faculty is actually represented in the cold, black lines. Yet, of a few rough strokes, the master mind has made such an *ensemble* that we have a true picture of beauty in the expression of physical and mental life. Just so our master of mental measurements will bring together facts, which in themselves may seem meaningless, into an *ensemble*, which adequately represents the individual singer, or some feature of her, for our purpose.

Turning to the second question, as to whether such a measure can be said in any sense to be adequate, let us take an illustration. A man has a richly varied and well-cultivated garden. He is an horticulturist and cultivates the garden for scientific observation, pleasure and table use. Now what would constitute an adequate measure of that garden? It is possible to determine to a high degree of accuracy the

exact size, form and weight of every living plant, the rate of growth of each and every leaf, root, flower and fruit, the absorption rate for each and every chemical element drawn from the soil, the rate of increase in tensile strength, the deposit of chlorophyl, the internal structure of each and every cell, etc., *ad infinitum*. The possibility of measurement is here practically unlimited. An adequate measure is, however, not a complete measure, but one which answers a purpose. The gardener measures the specific thing which he wants to know.

Now, the human psycho-physical organism is at least as rich and as varied as a well-cultivated garden, if we may make so crude a comparison. While mental measurements are not developed to the same degree of precision as those of the gardener, they are nevertheless possible and may be quite as serviceable. The question is not how many measures are possible. No sane individual would ever undertake to make all possible measurements on a singer. The question is this: Can we command measurements which shall answer our present purpose? In the present case, do these measurements give us an adequate estimate of the various capacities and qualifications of this individual as a singer? The list here given is therefore not an attempt to show how many can be made, but to suggest which of those available may answer our purpose, and, when taken together, prove an adequate measure.

In the way of mental measurements, we can get practically what we want, provided we are willing to deal with specific facts. Our present list makes a formidable array, yet it is limited to those for which I, though not an expert in this field, know methods and means of measurement, and to such as are essential to a reasonably representative survey of the matters to which

they pertain; and measurements which would result if any given point were followed up intensively are not mentioned. To the extent that they are representative and no essential feature is overlooked, they constitute an adequate measure of an individual as a singer.

There is a continual warfare between psychology, as a science, and the demands in practical life for a single general measure for some practical purpose. Much work has been done on the naïve assumption that a single measure of a cognitive capacity should serve as a general measure of intelligence. Space discrimination, reaction after choice, the memory span, and such specific cognitive measures have been used in seeking correlations with some sort of generally recognized intelligence, but of course in vain. For psychology demands that each measurement shall deal with something specific and fairly homogeneous, and the record pertains only to the factor under control. Our gardener's measure of the quality of tomatoes may or may not represent a quality of his potatoes, peas or roses. Each article must be measured by itself. So, only when we have collected a sufficient number of data to feel that all the essential and fundamental traits of intelligence are represented, can we speak of an adequate measure of intelligence. The same principle applies to the measure of musical ability.

Turning to the third question, as to the significance of a measure of a singer, we note that, if it is adequate, it places at the disposal of those who can profit by it a classified invoice of useful facts about this singer in such a way that it may be of direct value. The advice based upon such an invoice should be weighed by the expert, the facts should be laid before the teacher, and the pupil should realize that she has become objectified to herself in

such a way that she knows herself with reference to her possibilities as a singer better than she could possibly have learned in any other way. Her future career as a singer may be determined by this and like knowledge which may be gained from time to time. It is doing for her what an invoice does for the banker before he makes a large investment. If her case is promising the record is most stimulating and encouraging. If there is insuperable cause for failure, it may in a very true sense save life by preventing its wreckage upon the stage after long wasted effort. The record shows whether she is by nature endowed with the mind and body of a natural singer, and to what extent for each item; and it points out to her the high places and the low places in her capacities and possibilities. It substitutes procedure with knowledge, for the haphazard procedure which has always been followed in music.

In giving and taking advice of this sort we must, however, not forget the enormous resourcefulness of the human will, and the possession of latent powers. A one-legged man may become a rope dancer, a blind man a guide, a man with wretched voice an orator. Furthermore, art is possible only where there is willingness to overlook faults. A singer may be permanently lacking in some fundamental capacity and yet have such merits in other respects, or have such exceptional ability in covering, that she may be successful in spite of an overt handicap. But even then psychology has warned and explained.

This invoice also serves to explain experience of the past which may not have been understood. If the singer has had defeat, it will show exactly why. If she has been misguided in musical training, it may show the nature of the error and its results. If the singer is conscious of lack in some capacity, the record shows the na-

ture of this lack and may even suggest a remedy, if such there be. Even among the best musicians it is rare to find some one who does not have some type of difficulty. Indeed, the difficulties of the singer are notoriously great. If psychological measurement can lend a hand through the laying bare of the condition of the difficulty and by determining its nature and extent, as well as by discovering those who may not be aware of their genuine ability, it will indeed be in this respect a hand-maid of music.

Another effect of such measurements is not only to objectify the elements of musical appreciation and expression in such a way as to deepen insight in the expert, the teacher and the pupil; but it will also be reflected in the science and art of music as the scientific conceptions become generally known. The measurements will furnish a sort of skeleton for the psychology of music.

From the very nature of his art, the musician, as a rule, takes the same kind of attitude toward his performance as an author of high national reputation took to the Ouija board, which I had the pleasure of observing in action. In a certain sitting where the Ouija board was being shown, I remarked upon the extraordinary quickness of the sitter's eye in reading the spelled words. "Eye," he said. "Do you think I use my eyes?" "Let us try it. Close your eyes and proceed." Just as he started, I slid the board an inch to the side, and of course the rider did not hit a letter correctly. The performer was completely astonished. He had engaged in more than one hundred and fifty successful sittings, and yet he had not become aware of the fact that the use of his eyes was essential to his success. The message had come to him as a communication from without. The demand for so-called inspiration in

music develops this attitude. The musician proceeds with a remarkable unconsciousness of the elements involved both in the appreciating and performing of music. Any musician who is invited into the psychological laboratory where experiments in the psychology of music are performed, will demonstrate this, which is an entirely natural fact and casts no reflection upon him. The psychology of music for musicians has not yet come into existence. Its coming depends upon the recognition psychologists will give to the possibility of psychological measurements in music. The musician waits for the psychologist to blaze the trail. He is a most docile inquirer when opportunity is given. The perspective of music, and the perspective of the musician, which is gained by the objectifying of factors involved, will be projected into our common account of music, and this will vitalize musical ideas and furnish the singer a more general insight into his capacities and possibilities.

Such features of the psychology of music will form a foundation for musical pedagogy. Last year the director of a great symphony orchestra brought his instrumental and vocal soloists into the psychological laboratory and there performed a large number of experiments on them. Everything proved practically new to these musicians and yet they did not tire in pointing out what a great help each and every measurement would be in their training if they were available. Take one example—the measurement of the pitch of an instrumental or vocal tone as seen in direct reading on an instrument in the laboratory. Orchestra leaders and soloists continually differ in regard to the pitch sung or played under given circumstances. The director called up the players of the oboe, the French horn and the first violin, in turn, and the instant each played, the re-

cording instrument showed, to a small fraction of a vibration, how much the tone played varied from the true tone, and disputes of long standing were settled in a moment. The conductor then proceeded in the same way with his vocal soloists. They all saw their faults and fortes pictured quantitatively on the instrument, and left the laboratory unanimous in the verdict that the introduction of such psychological measurements into the conservatory would be a great step in the advancement of musical instruction.

It is the business of the psychological laboratory to develop measuring instruments and methods, and to standardize them because, when the musician employs any of these measurements, he is employing psychological, and not musical, technique.

Measurements of this sort may be divided into four groups according as they represent essentially natural capacity, plasticity (that is, capacity for learning), acquired skill, and knowledge; and, in each and all of these phases, the art of music would profit by such facts.

After all, pure psychology will be the chief gainer. One can not observe under controlled conditions in a field so rich and unworked without gathering new facts, correcting errors, broadening views and deepening insight into the nature of the mental processes involved in music. Applied psychology of music is to pure psychology of music as engineering is to physics; they must go hand in hand. Neither stands higher nor lower than the other in the rank of merit as a pursuit. And especially at the beginning of such an applied science as psychology, too high a value can not be placed upon the matter of laying solid theoretical foundations before we begin to work for practical results.

In conclusion, then, what is the lesson of

our illustration? The message I have attempted to convey may be stated in the following propositions:

1. Technical psychology may be so employed as to furnish qualitative and quantitative classified knowledge about a singer.

The question as to the nature of mental measurement does not enter into this discussion. That question has had its day. I am using the term measurement in the accepted sense in which we use it every day in the psychological laboratory, taking for granted that there is general agreement in regard to its nature and its limitations. The selection has been made on the theory that measurements of the kind we commonly accept in psychology may be so employed as to furnish a serviceable invoice of the natural capacity, plasticity, skill and knowledge a particular individual may have for doing a particular thing.

2. This more or less exact knowledge may be so gathered as to serve immediate and direct practical purposes. We have insistent demands for applied psychology from the various arts, professions and sciences. Our illustration shows how one such demand may possibly be met. The effect of such an illustration should be to awaken confidence in our method, to awaken a wholesome respect for actual facts, and to ward off superficial and hasty promises of results.

3. Applied psychology, if such there is to be, must be experimental in method and spirit. It is the introduction of the principle of measurement that has given us a science of pure psychology; and there will be no science of applied psychology until the same principle is believed in and acted upon seriously by those who would make its applications. This does not imply a narrow insistence upon experiments everywhere, but rather a whole-hearted accept-

ance of the spirit of experimental method.

4. There is need of consulting psychologists, trained in pure psychology and in the work to which it is to be applied, who shall devote themselves professionally to applied psychology. The field of the psychology of music is promising.

5. This attitude of modern psychology toward the human individual and the art of music will lead to a keener and more penetrating insight into the nature and the conditions of both the individual and his art, and this will result in helpful guidance and a more vital appreciation and respect for the wondrous possibilities of the singer and the song.

6. We must not entertain the idea that applied psychology is to live merely upon the crumbs that fall from the table of pure psychology, nor that it can be reduced to a set of ready-made rules which may be handed down to the uninitiated. Applied psychology "must recognize itself, its diversities, its stupendous difficulties, its essential limitations and withal its promise and worth."⁶

CARL E. SEASHORE

UNIVERSITY OF IOWA

THE AMERICAN SCHOOL HYGIENE ASSOCIATION

THE next meeting of the American School Hygiene Association is scheduled to occur in Boston, March 28, 29 and 30, probably at the Harvard Medical School. The following is a partial program for the meeting: Demonstrations of ventilating systems, school nursing, medical inspection, out-of-door schools and school furnishings in certain public and private schools of Boston; reports of committees on "Ventilation," and on "Standardization of School Books"; papers by Dr. Ernest B. Hoag, lecturer on hygiene, University of California; Willard S. Small, principal, Eastern High School, Washington, D. C.;

⁶ Seashore, "The Consulting Psychologist," *The Popular Science Monthly*, March, 1911, p. 290.